

# Structured Models for Written Music Processing

## PhD proposal

### Description.

Music Information Retrieval (MIR) is a multidisciplinary field concerned with the processing, organization, access and analysis of musical content in various formats such as audio recordings, symbolic performance recordings (MIDI), musical scores... Approaches developed in this area rely on different acoustic models and language models. The latter are often based on sequential (1D) or geometric (2D) representations of musical events (notes with attributes of pitch, start time and duration).

Common Western Music Notation (CWN) is a graphical format used since centuries as a crucial vector for knowledge transmission in musical practice. Although based on a relatively small number of symbols, this format is much more structured and conveys more information than the aforementioned representations. It indeed describes local and non-local relationships and a hierarchical organization of melodic and harmonic content in rhythmic groups, sentences *etc.* Such informations are useful to musician for the understanding and interpretation of pieces, and can also be exploited in MIR tasks.

The objective of this PhD is to study (i) structured music representations sharing fundamental properties with CWN, (ii) language models & formalisms based on such representations and (iii) their application to several MIR tasks. We shall in particular focus on the two following problems for these models:

- the construction of index for fast retrieval in digital music score databases,
- the definition and efficient computation of similarity metrics like edit distances.

Applications considered the PhD work may include (without being necessary limited to): The development of tools useful in the context of the analysis or edition of music scores *e.g.* for the comparison of score files or the quantitative evaluation of measures of notational quality or complexity; Information retrieval in databases of digital music scores, *e.g.* for melodic search, pattern extraction, identification of similar fragments *etc.*; The use of our language models as intermediate representation (and referential) in order to leverage processing tasks to heterogeneous content, in various encoding formats (`MusicXML`, `MEI`, `MXL`, `Lilypond`, `Guido`, `kern**` ...).

In order to motivate these applications, a particular attention will be dedicated to the development of a relevant use case in computational musicology, in collaboration with musicologists at Sorbonne University. Developments of collections and tools will be integrated in the base [Neuma](#) to demonstrate the practical impact and to disseminate the project's results.

## Context.

This PhD scholarship is funded by [Inria](#)'s exploratory action Codex (2020-2023), a research project on the generation and processing of written music. It will take place within the team Vertigo, *complex data, learning and representations* of [Cedric laboratory](#), in CNAM institute, Paris, France, under the supervision of Florent Jacquemard and Philippe Rigaux.

The goal of project Codex is to contribute to the development of numerical methods for the processing of written music, in particular the problems of automated music transcription, computational musicology, research and indexing in the collection of digital scores, as well as crowdsourcing approaches for score digitization and edition.

This multidisciplinary project gathers partners in Musicology: IReMus CNRS unit at Sorbonne University, Paris, Library Science: French National Library (BnF), and Computer Science: TRS lab at Nagoya University (via fundings by Yamaha Music Foundation & JSPS).

## Conditions.

The fellowship will start in October, for a duration of three years, with annual evaluations. Conditions are aligned with French doctoral contracts at INRIA, *i.e.* roughly 1700 euros net/month. The applicant should hold a Master degree in computer science which would formally entitle her/him to embark on a doctorate for the academic course 2020-2021 at this institute.

We expect a strong profile in Computer Science and Music Information Retrieval. Prior knowledge in music representations (audio or symbolic) would be much appreciated. A real interest for interdisciplinary collaborations is also important.

## Application process.

Candidates should send us a cover letter and a resume by July, 15 2020 to the address of the first supervisor : `firstname.lastname at inria.fr`.

The letter must contain a brief research proposal fitting to the PhD proposal, that demonstrates some prior understanding of the issues pertaining to the study of music notation models and applications.

To check and discuss the adequacy between their profile and these topics, candidates should feel free to contact beforehand on the same address and CC to the second supervisor

`firstname.lastname at lecnam.net`.